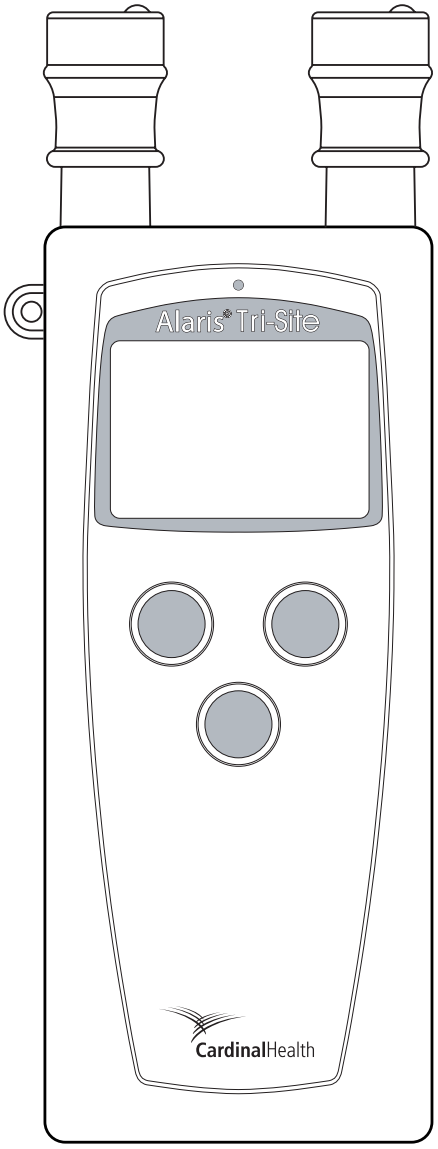
# Technical Service Manual

Alaris® Tri-Site Thermometer

Models 228XXX

May 2006




CardinalHealth

Alaris® Products

## General Contact Information

Cardinal Health
Alaris® Products
10221 Wateridge Circle
San Diego, California 92121
USA
http://www.cardinal.com/alaris

Cardinal Health
The Crescent, Jays Close
Basingstoke, Hampshire, RG22 4BS,
United Kingdom
http://www.cardinalhealth.co.uk/alaris

### Customer Advocacy

Clinical and technical feedback.

North America:
Phone: 800.854.7128, Ext. 7812
E-Mail: CustomerFeedback@cardinal.com

International:
E-Mail: international.product.complaints@cardinal.com

### Technical Support - North America

Maintenance, service information support, and troubleshooting.

United States:
Phone:
858.458.6003
800.854.7128, Ext. 6003

Canada:
Phone:
Eastern: 800.387.8309
Western: 800.387.8309

### Customer Care - North America only

Instrument return, service assistance, and order placement.

United States:
Phone: 800.482.4822

Canada:
Phone: 800.387.8309

### Technical and Customer Services - UK only

Maintenance and service information support.
Instrument return, service assistance, and order placement.

Customer Service:
Freephone: 0800 917 8776
E-Mail: UK-Customer-Service@cardinal.com

Technical Service:
Freephone: 0800 389 6972
E-Mail: UK-Technical-Support@cardinal.com

### International Service Contacts

For service or technical information, contact the nearest Cardinal Health Affiliate Office, your local representative, or see: http://www.alarismed.co.uk/technical/contacts.html

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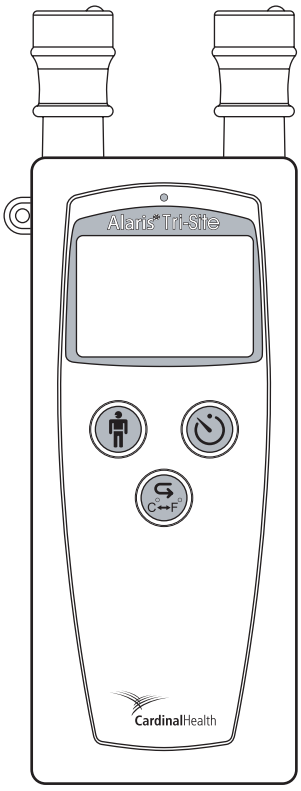
# 1 GENERAL INFORMATION

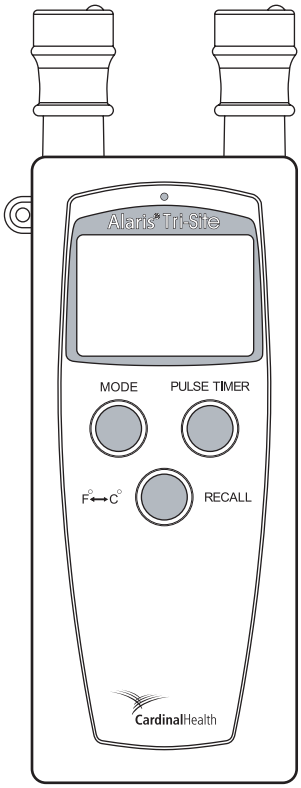
# Chapter 1 — GENERAL INFORMATION

⚠ To avoid damaging the keypad, do not use sharp objects (pens, pencils, etc.) to activate switches.

⚠ Any attempt to service this product by anyone other than an authorized Cardinal Health Service Representative while the product is under warranty may invalidate the warranty.




**Alaris® Tri-Site thermometer (International version)**




**Alaris® Tri-Site thermometer (North American version)**

## 1.1 INTRODUCTION

This technical service manual describes how to maintain and service the Alaris® Tri-Site thermometer in its North American and International versions.

The North American and international versions of the thermometer function identically and require the same maintenance and service. The North American version is labeled in English, and the international version uses icons.

The Alaris® Tri-Site thermometer is available in nine models (see Table 1-1) and uses only P850A disposable probe covers.

This manual is intended for personnel experienced in analyzing, troubleshooting and repairing analog and digital electronic equipment. The Alaris® Tri-Site thermometer Directions for Use describes how to set up and operate the thermometer.

## 1.1 INTRODUCTION (Continued)

The Alaris® Tri-Site thermometer includes a thermometer, a home base, probes, and attachment options.

Table 1-1 summarizes thermometer package contents according to model and version:

### Table 1-1. Thermometer Models/Versions Covered by this Technical Service Manual

| Model/ version | Portable | Wall Mount | Oral/ Axillary Probe (blue) | Rectal Only Probe (red) | Home Base | Carrying Strap | Probe Cover Dispenser |
|---|---|---|---|---|---|---|---|
| 2280OR (North America) | X | | X | X | X | X | X |
| 2280O (North America) | X | | X | | X | X | X |
| 2280R (North America) | X | | | X | X | X | X |
| 2285OR (North America) | | X | X | X | X | | X |
| 2285O (North America) | | X | X | | X | | X |
| 2285R (North America) | | X | | X | X | | X |
| 2281OR (International) | X | | X | X | X | X | X |
| 2281O (International) | X | | X | | X | X | X |
| 2281R (International) | X | | | X | X | X | X |

## 1.2 WARNING DEFINITIONS

Refer to the Alaris® Tri-Site thermometer DFU.

## 1.3 SPECIFICATIONS

Refer to the Alaris® Tri-Site thermometer DFU.

## 1.4 OPERATING FEATURES, CONTROLS AND INDICATORS

Refer to the Alaris® Tri-Site thermometer DFU.

## 1.5 ACCESSORIES

Refer to the Alaris® Tri-Site thermometer DFU.

## 1.6 CUSTOMER AND TECHNICAL SERVICE

Refer to “General Contact Information” at the front of this manual.

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# 2 CHECKOUT & CONFIGURATION

# Chapter 2 — CHECKOUT AND CONFIGURATION

⚠ Remove the thermometer from use immediately if it is dropped or severely jarred. Qualified service personnel must thoroughly test and inspect the thermometer before returning to use.

## 2.1 INTRODUCTION

This chapter describes initial setup and configuration for the Alaris® Tri-Site thermometer. Due to product changes over time, configurations described in this chapter may differ from the instrument being serviced.

## 2.2 NEW INSTRUMENT CHECKOUT

Refer to the thermometer Directions for Use (DFU) for instructions regarding unpacking and setup for first time use.

At power up verify the that the thermometer beeps and all LCD elements flash. This confirms that the thermometer has passed its self test and is operating correctly. The thermometer continually performs a self test during operation and alarms and displays a message if it detects an internal malfunction.

## 2.3 CHANGING FACTORY DEFAULT SETTINGS

### 2.3.1 Mode and Scale

The thermometer factory default settings for mode and temperature scale are Fast Oral mode, Fahrenheit (°*F*) temperature scale.

To change the default settings:

1. Press Pulse Timer button for 15 seconds (until LCD display test begins).
2. To change default settings:
   Press the Mode button until the screen displays the desired mode.
   Press the Recall/Temperature Scale button until the screen displays the desired temperature scale.
3. Press Pulse Timer button or remove probe from well to save the new default settings.

### 2.3.2 Anti-Theft Timer Interval

Refer to “Anti-Theft Timer Configuration” in Chapter 5 (Corrective Maintenance).

⚠ Thermometer settings revert to default values following battery replacement. Qualified hospital/facility personnel must ensure that hospital-approved default settings are selected.

# 3 PREVENTIVE MAINTENANCE

# Chapter 3 — PREVENTIVE MAINTENANCE

⚠ Failure to perform regular and preventive maintenance inspections may result in improper thermometer operation.

## 3.1 INTRODUCTION

Perform regular and preventive maintenance inspections to ensure that the thermometer remains in good operating condition:

- Perform regular inspections for damage and cleanliness before each use as described in the Alaris® Tri-Site thermometer DFU.
- Perform preventive maintenance inspections annually.

These requirements and guidelines are intended to complement the intent of Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements.

Electrical safety tests are not required for battery-powered devices.

## 3.2 PREVENTIVE MAINTENANCE

Qualified service personnel must perform these periodic maintenance procedures annually:

- Visual inspection (section 3.2.1).
- Startup check (section 3.2.2).
- Pulse timer check (section 3.2.3).
- Calibration check (section 3.2.4).
- Probe simulator calibration, if applicable (section 3.2.5).

Cardinal Health offers service agreements for performing required periodic inspections.

### 3.2.1 Visual Inspection

Check the case, display, and probes for damage and cleanliness. (Section 3.3 describes how to clean the thermometer).

### 3.2.2 Startup Check

The Startup Check includes a power-on test, functional test, backlight test, and display test.

#### Power-On Test

1. Install batteries into thermometer.
2. Verify that the screen displays all segments, then beeps and displays the Return to Base symbol or message.
3. Return thermometer to home base.
4. Verify that beeping stops and display is blank.

#### Functional Test

1. Insert an oral probe into the blue well. Insert the connector into jack #2.
2. Remove probe from storage well.
3. Verify that the instrument beeps once and that all segments except the Pulse Timer clock momentarily turn on.
4. When this sequence is complete (1 to 2 seconds), verify that the instrument displays the Fast Oral Mode symbol or message.
5. Verify that no alarms occur for 10 seconds, then return probe to well.
6. Verify that thermometer beeps once and display is blank.
7. Verify that no alarms occur for 30 seconds (thermometer automatically tests heater interlock circuits).
8. If applicable, repeat procedure for rectal probe (insert into red well and connect to jack #1).

#### Backlight Test

1. Use black tape to cover hole above LCD.
2. Press and release Pulse Timer button, then verify that backlight is on.
3. Press and release Pulse Timer button again, then verify that backlight is off.
4. Remove black tape.

#### Display Test

1. Press and hold Pulse Timer button for 15 seconds, until the LCD displays the software revision.
2. Release Pulse Timer button. Display test begins within 2 seconds: verify that each segment flashes.
3. Press and briefly hold Pulse Timer button to exit test and turn thermometer off.

### 3.2.3 Pulse Timer Check

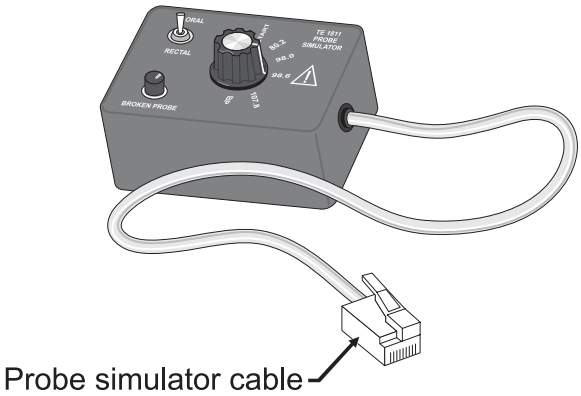
1. Press and hold Pulse Timer button for one second. Verify that a short beep sounds and the 12-segment timer symbol appears.
2. Verify that one segment disappears every five seconds.
3. Verify that thermometer beeps:
   - once at 15 seconds
   - twice at 30 seconds
   - three times at 60 seconds
4. Press Pulse Timer button to stop timer operation at any time: verify that thermometer beeps three times and timer symbol turns off.

### 3.2.4 Calibration and Probe Detection Check

The calibration check verifies that the microprocessor can correctly measure and convert circuit resistance to a temperature value. The probe detection check verifies that the thermometer can detect that the correct probe is in the correct jack.

Perform the calibration check using a probe simulator, resistance decade box, or circulating water bath. Perform the probe detection check using a probe simulator or resistance decade box.

**Figure 3-1. Probe Simulator (Model TE 1811)**




**Probe Simulator Method**

1. Verify that thermometer is silent and display is blank when no probes are connected or installed in wells. Set thermometer to Oral Continuous/Monitor mode.
2. Set probe simulator to RECTAL and START positions.
3. Connect probe simulator cable to jack #2 (blue side), and verify that error message **3** appears.
4. Set probe simulator to ORAL, and verify that thermometer displays Oral Continuous/Monitor Mode symbol or message.
5. Set probe simulator to the values listed in Table 3-1, then verify displayed temperatures.
6. Set probe simulator to BP, then press BROKEN PROBE button. Verify that error message **67** appears.
7. Disconnect probe simulator cable. Again verify that thermometer is silent and display is blank. Set thermometer to Rectal Continuous/Monitor mode.
8. Set probe simulator to ORAL and START positions.
9. Connect probe simulator cable to jack #1 (red side), and verify that error message **3** appears.
10. Set probe simulator to RECTAL.
11. Verify that thermometer displays Rectal Continuous/Monitor Mode symbol or message.
12. Set probe simulator to the values listed in Table 3-1, then verify displayed temperatures.

**Table 3-1. Probe Simulator Settings/ Displayed Temperature**

| Probe Simulator Setting | Displayed Temperature |
|---|---|
| 80.2 °F | 80.2 ± 0.2 °F or 26.8 ± 0.1 °C |
| 98.0 °F | 98.0 ± 0.2 °F or 36.7 ± 0.1 °C |
| 98.6 °F | 98.6 ± 0.2 °F or 37.0 ± 0.1 °C |
| 102.0 °F | 102.0 ± 0.2 °F or 38.9 ± 0.1 °C |
| 107.8 °F | 107.8 ± 0.2 °F or 42.1 ± 0.1 °C |

### 3.2.4 Calibration and Probe Detection Check (Continued)

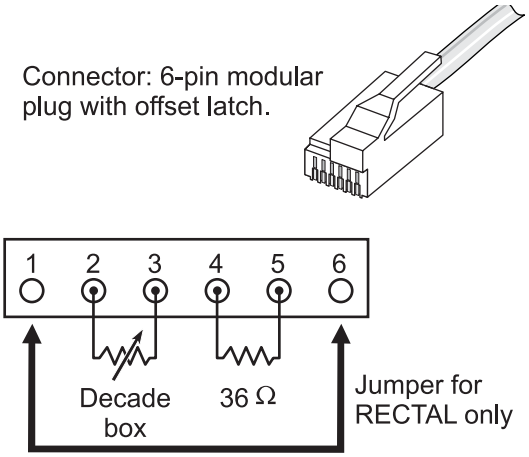
**Probe Simulator Method** (Continued)

13. Set probe simulator to BP, then press BROKEN PROBE button. Verify that error message **68** appears.
14. Disconnect probe simulator cable.

***Resistance Decade Box Method***

1. Connect the resistance decade box as shown in Figure 3-2.

**Figure 3-2. Resistance Decade Box**




2. Verify that thermometer is silent and display is blank when no probes are connected or installed in wells. Set thermometer to Oral Continuous/Monitor mode.
3. Connect resistance decade box cable to jack #2 (blue side), and verify that thermometer beeps and displays Oral Monitor/Continuous Mode message or icon.
4. Set resistance decade box to the values listed in Table 3-2, then verify displayed temperatures.

**Table 3-2. Resistance Decade Box/ Displayed Temperature**

| Resistance Setting | Displayed Temperature |
|---|---|
| 6097 Ω | 98.0 ± 0.2 °F or 36.7 ± 0.1 °C |
| 9254 Ω | 80.2 ± 0.2 °F or 26.8 ± 0.1 °C |
| 6015 Ω | 98.6 ± 0.2 °F or 37.0 ± 0.1 °C |
| 5570 Ω | 102.0 ± 0.2 °F or 38.9 ± 0.1 °C |
| 4895 Ω | 107.8 ± 0.2 °F or 42.1 ± 0.1 °C |

5. Set the resistance decade box to a value greater than 1 MΩ and verify that error message **67** appears.
6. Disconnect probe simulator cable. Again verify that thermometer is silent and display is blank. Set thermometer to Rectal Continuous/Monitor mode.
7. Connect jumper between connector pins 1 and 6, then connect cable to jack #1 (red side).
8. Set resistance decade box to the values listed in Table 3-2, then verify displayed temperatures.
9. Set the resistance decade box to a value greater than 1 MΩ and verify that error message **68** appears.

### 3.2.4 Calibration and Probe Detection Check (Continued)

**Circulating Water Bath Method**

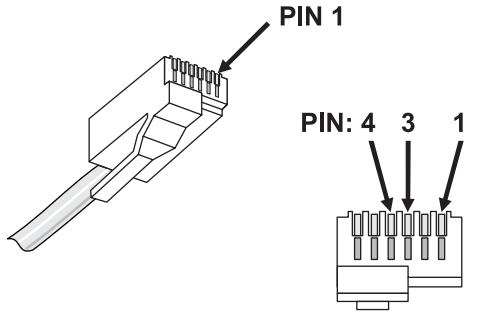
1. While pressing and holding the pulse timer button, remove a probe from the probe well. Release the pulse timer button.
2. Verify that thermometer displays Oral or Rectal Continuous/Monitor Mode symbol or message.
3. Install a probe cover over the probe and insert the probe 2.5 to 3 inches into water bath.
4. Leave probe in place for at least two minutes.
5. Verify that displayed temperature is within ±0.2 °F (±0.1 °C ) of actual water temperature.

### 3.2.5 Probe Simulator Calibration Verification

Verify calibration of the probe simulator (if used) annually. Verification requires a FLUKE Multimeter Model 8800A or equivalent 5 1/2 digit meter.

1. Set multimeter to K OHMS, RANGE 20.
2. Measure between pins 2 and 3 of the probe simulator plug (Figure 3-3), then verify resistance measurements (Table 3-3).

**Figure 3-3. Probe Simulator Cable Plug**




3. The probe simulator fails if measured values are not within specified ranges.

**Table 3-3. Probe Simulator Verification**

| Probe Simulator Setting | Multimeter Reading |
|---|---|
| 80.2 | 9250 to 9258 |
| 98.0 | 6093 to 6101 |
| 98.6 | 6011 to 6019 |
| 102.0 | 5566 to 5574 |
| 107.8 | 4891 to 4899 |
| BP and BROKEN PROBE button pressed | Open circuit |

## 3.3 CLEANING

Qualified service personnel must clean thermometer buttons as required. Refer to the Alaris® Tri-Site thermometer DFU for all other cleaning instructions.

### 3.3.1 Cleaning Thermometer Buttons

Clean thermometer buttons periodically: dried matter under buttons can affect response to button presses. To clean button pad:

1. Remove batteries and screws that attach front and back of thermometer, then remove front case.
2. Gently remove button pad from front case, and inspect for damage. If any damage is visible, replace before returning device to use.
3. Use an approved cleaning solution to clean as necessary.
4. Reassemble button pad into front case, align locator pins and cutouts to ensure correct position.
5. Replace screws to attach front and back of thermometer, then replace batteries.

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# 4 PRINCIPLES OF OPERATION

# Chapter 4 — PRINCIPLES OF OPERATION

## 4.1 INTRODUCTION

This chapter describes the principles of operation for the Alaris® Tri-Site thermometer and its major subsystems.

## 4.2 OPERATION OVERVIEW

The Alaris® Tri-Site thermometer uses a thermistor in the tip of the probe to sense temperature. Temperature changes cause an inverse, nonlinear change in thermistor resistance.

The thermistor's output voltage represents the measured temperature, and is fed to the thermometer's microcomputer. The microcomputer then drives the thermometer screen to display the temperature.

Temperature calculations differ according to whether the Continuous or Fast (predictive) method is in use. Either method can be used at any of three body sites (oral, axillary, or rectal). The combination of measurement method and body site is called the *mode*.

System power up begins when batteries are installed in the thermometer (once batteries are installed, the thermometer alarms until it is returned to home base).The thermometer performs self tests of its RAM, ROM, LCD, reference voltages, audio system, battery voltage, and anti-theft feature. If self testing does not complete within an expected time limit, the thermometer alarms.

Once self testing is complete, the thermometer continuously checks its status and alarms if an error is detected. Operator inputs to the thermometer include button presses, connecting probes to the thermometer, and installing and removing probes.

## 4.3 CONTINUOUS MEASUREMENT METHOD

During the Continuous measurement method, the thermometer's microcomputer converts data from the probe directly to a temperature and displays it in the selected temperature scale (celsius or fahrenheit).

A continuous temperature reading generally takes 3 - 5 minutes to stabilize, and the displayed temperature reflects the current measurement as long as the probe is not in its probe well. This method is used for continuous temperature measurements that last less than an hour, or when the thermometer cannot calculate a temperature using the Fast method.

## 4.4 FAST MEASUREMENT METHOD

During the Fast (predictive) measurement method, the thermometer applies power to a heating element in the probe tip to allow the probe to reach a predefined target temperature that is close to the temperature at the body site.

The thermometer's first measurement verifies that ambient temperature is within the specified operating range (16.0 to 33.3°C or 60.8 to 92°F). If not, the thermometer exits the Fast method and uses the Continuous method.

If the thermometer switches to the Continuous method, one long beep and a changed mode indicator signal the change. The thermometer also uses the Continuous method if the final predicted temperature is below 35°C (95°F) or above 41°C (106°F), or if it cannot complete the temperature prediction within 22 seconds (oral/rectal temperatures) or 30 seconds (axillary temperatures).

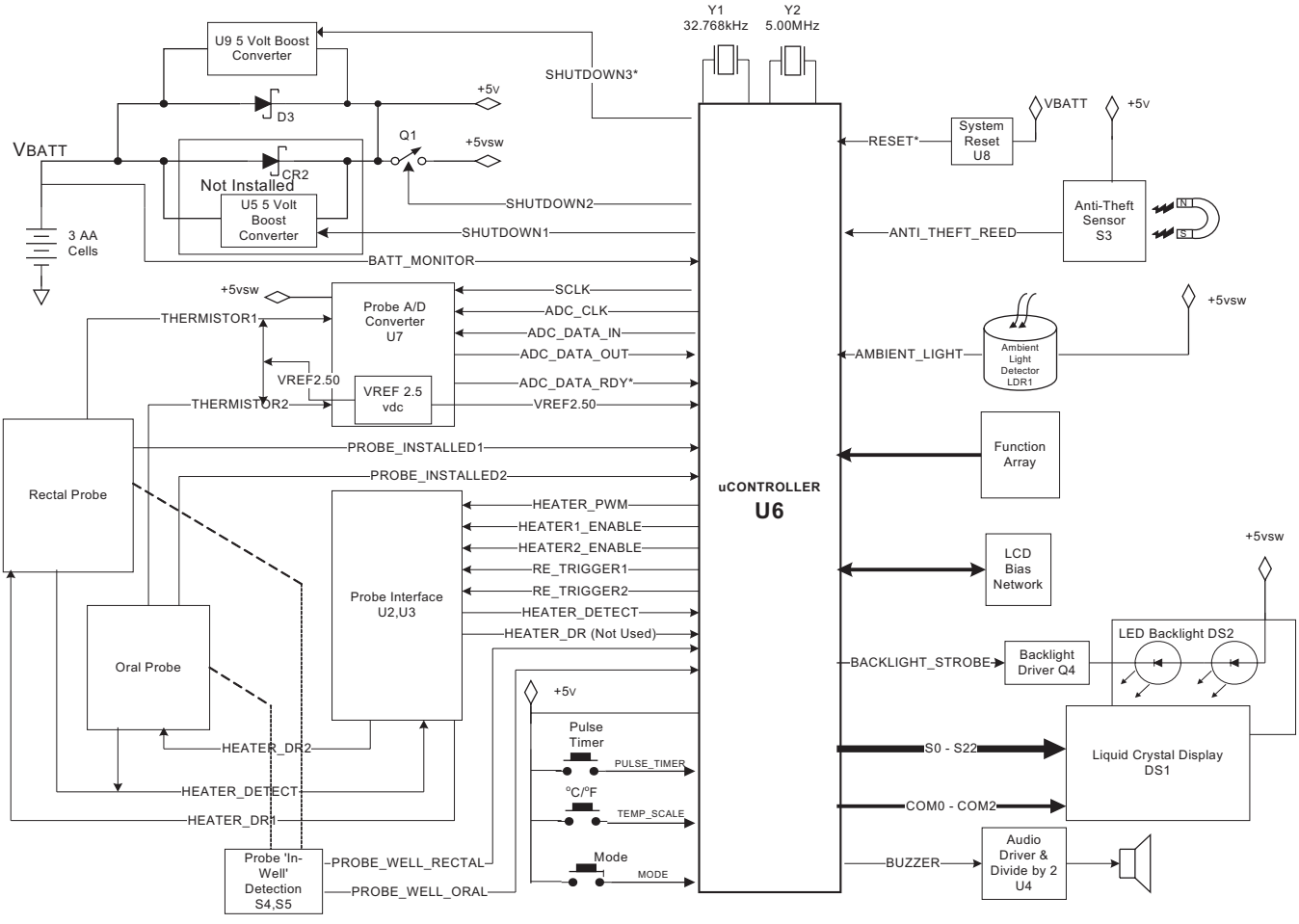
When probe temperature reaches 34°C (94°F), the thermometer assumes that tissue contact is established and displays the tissue contact indicator. When probe temperature rises above the predefined target, the heater shuts off.

Once the heater shuts off, the thermometer computes an estimate of the steady state temperature by sampling temperature every 100 milliseconds and comparing it to a theoretical curve. This technique allows the Fast method to estimate a temperature within seconds, without having to wait several minutes for the probe's thermistor tip to reach the same temperature as the tissue. When the thermometer reaches a final estimate, it beeps three times and displays the temperature for 45 seconds or until the probe is reinserted into its well.

## 4.5 THERMOMETER SUBSYSTEMS

This section describes subsystems of the Alaris® Tri-Site thermometer, including microcomputer, DC power regulation, probe, LCD, audio, and anti-theft timer. Figure 4-1 shows a block diagram of the thermometer.

**Figure 4-1. Block Diagram**



## 4.5 THERMOMETER SUBSYSTEMS (Continued)

### 4.5.1 Microcomputer

The microcomputer controls all thermometer functions. It is powered whenever the batteries are installed and operates in awake or sleep states. The thermometer measures temperatures and operates the pulse timer in the awake state. The thermometer is partially shut down in the sleep state to conserve power. Pressing a button or removing a probe from its well puts the microcomputer into the awake state.

The microcomputer controls the LCD and monitors the voltages that maintain DC power, detect probe(s) installed, LCD backlight operation, and probe heating.

Installing batteries resets the microcomputer, which causes the thermometer to revert to its default settings.

### 4.5.2 DC Power Regulation

The thermometer is designed to operate on three AA alkaline batteries, and includes circuitry that supplies a regulated 5 V DC to the device. During the sleep state, the thermometer only supplies enough voltage to power essential circuits.

The microcomputer monitors battery voltage and activates the low battery alarm indicator when battery voltage drops to 3.5 V. If battery voltage drops to 3.1 V, temperature measurement stops and the microcomputer activates the replace battery indicator.

### 4.5.3 Thermometer Probe Operation

Thermometer probes include an internal thermistor and heater element. The heater preheats the probe tip to a predefined target temperature when the Fast measurement method is in use. The microcomputer uses a closed loop circuit to control probe heating. The resistance of the probe thermistor varies, according to temperature. The microcomputer uses input voltages from the the thermistor and heater (if used) to compute temperature.

Signals from the probes allow the microcomputer to determine the probe type (oral/axillary or rectal), whether the probe is properly connected, and to prevent heater runaway.

If a software or microcomputer failure occurs, hardware watchdog circuitry protects heater elements from being over-driven. The microcomputer must continuously activate certain signals for the heater elements to remain on. Without these signals, watchdog circuitry blocks heater element operation.

The thermometer activates a broken probe alarm if the measured temperature is below 0°C (32°F) or above 260°C (500°F). The thermometer activates an overheated probe alarm if the measured temperature is over 46°C (115°F).

### 4.5.4 Liquid Crystal Display (LCD) Operation

The microcomputer controls the LCD by multiplexing voltages applied to segment pins with serial port states to turn display segments on and off.

A cadmium-sulfide cell whose voltage varies according to light detection acts as an ambient light sensor. The microcomputer monitors light sensor voltage and turns the display backlight (two LEDs) on and off.

### 4.5.5 Thermometer Audio

When an audio tone is required (an indicator beep or continuous alarm tone), the microcomputer generates a signal that activates the speaker.

### 4.5.6 Anti-Theft Feature

The thermometer is designed to alarm and stop operating if it is not returned to its home base within the required time frame. The factory default setting for the anti-theft timer interval is 8 hours. However, the timer can also be configured for 1 hour or timer off (refer to “Anti-Theft Timer Configuration” in Chapter 5, Corrective Maintenance). Removing the batteries does not reset the anti-theft timer.

A magnet embedded in the home base closes a switch in the thermometer. Removing the thermometer from home base opens the magnetic switch and starts a countdown timer. Returning the thermometer to its home base closes the switch and resets the timer.

For the default configuration of 8 hours, the microcomputer activates the return to home base indicator when about 1 hour of the anti-theft interval remains (that is, after about seven hours have elapsed). If the timer is configured for 1 hour, the return to home base indicator appears when 10 minutes of the interval remains. If the thermometer is not returned to home base before the interval expires, the anti-theft alarm activates and temperature measurement is disabled until the thermometer is returned to base. Returning the thermometer to home base cancels the alarm and resets the timer.

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# 5 CORRECTIVE MAINTENANCE

# Chapter 5 — CORRECTIVE MAINTENANCE

⚠ CMOS devices are sensitive to static electrical charges and may be damaged during repair if the repair activity is not performed in an electrostatic discharge (ESD) protected environment using approved ESD protective procedures, including personnel grounding. Any attempt to service this product by anyone other than an authorized Cardinal Health Service Representative while the product is under warranty may invalidate the warranty.

⚠ Due to product changes over time, components/ assemblies illustrated in this chapter may differ from the instrument you disassemble. If there are any questions, look for Service Bulletins related to this chapter or contact Cardinal Health Technical Support.

⚠ To avoid the risk of electrical hazard or damage to circuitry, do not spray fluids directly onto the instrument or allow fluids to enter the instrument.

## 5.1 INTRODUCTION

This chapter describes how to configure, disassemble, and reassemble the Alaris® Tri-Site thermometer .

The components on the circuit board are not field repairable. Return circuit boards to an authorized Cardinal Health Service Center for repair. Attempting circuit board repairs voids all warranties.

For more efficient repair, read Chapter 4 (Principles of Operation) for information on the thermometer.

For troubleshooting information, read Chapter 6 (Troubleshooting).

For information on replacement parts, read Chapter 7 (Illustrated Parts Breakdown).

Following any level of maintenance or repair, perform the applicable tests (refer to “Level of Testing Guidelines” table at the end of this chapter).

## 5.2 DISASSEMBLY/REASSEMBLY

Follow these procedures in order for the most efficient disassembly. To reassemble the thermometer, reverse the disassembly steps.

Before adhering gaskets and labels to the instrument, clean the surface with a cotton swab or soft cloth lightly dampened with 70% isopropyl alcohol.

### Table 5-1. Required Materials, Supplies and Tools

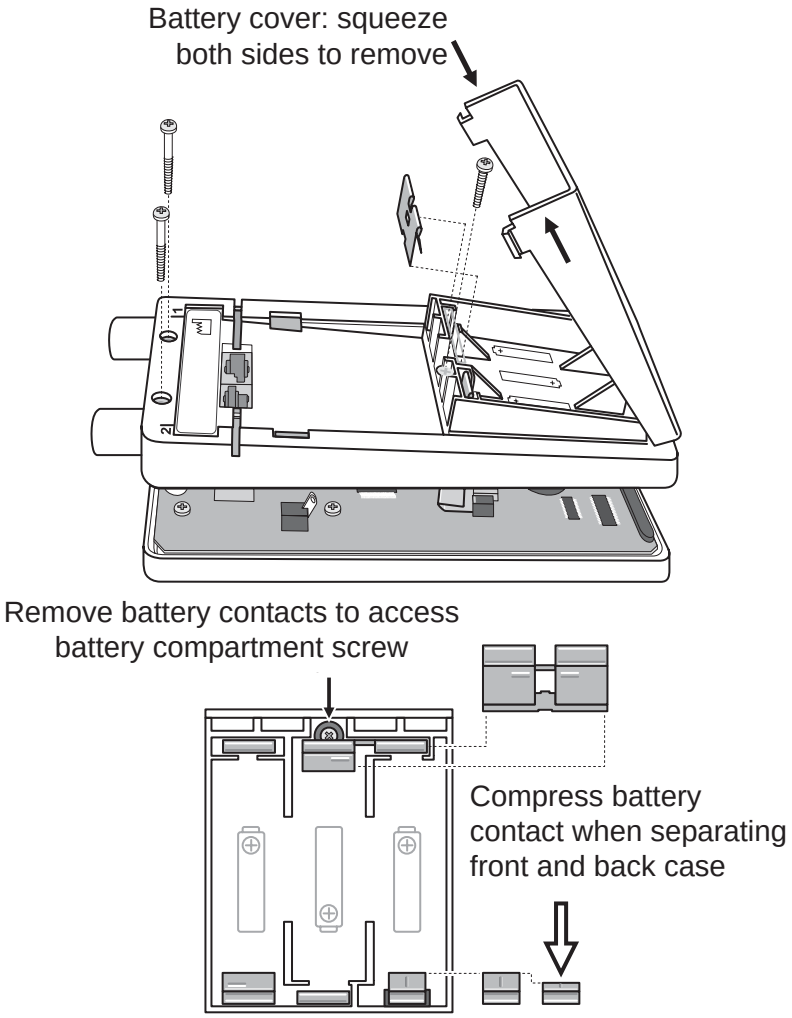
- Phillips screwdriver set

## 5.2 DISASSEMBLY/REASSEMBLY (Continued)

### 5.2.1 Opening the Case

1. Remove probe cover box.
2. Disconnect probes and remove from thermometer.
3. Remove battery cover: squeeze on one side, then the other, to unlock battery cover from case (Figure 5-1).
4. Remove batteries.
5. Remove battery jumper.
6. Remove the 2 screws at the top rear of the case and 1 screw at battery compartment.
7. Separate front and back case. The circuit board is attached to the front case.

**Figure 5-1. Opening the Case**

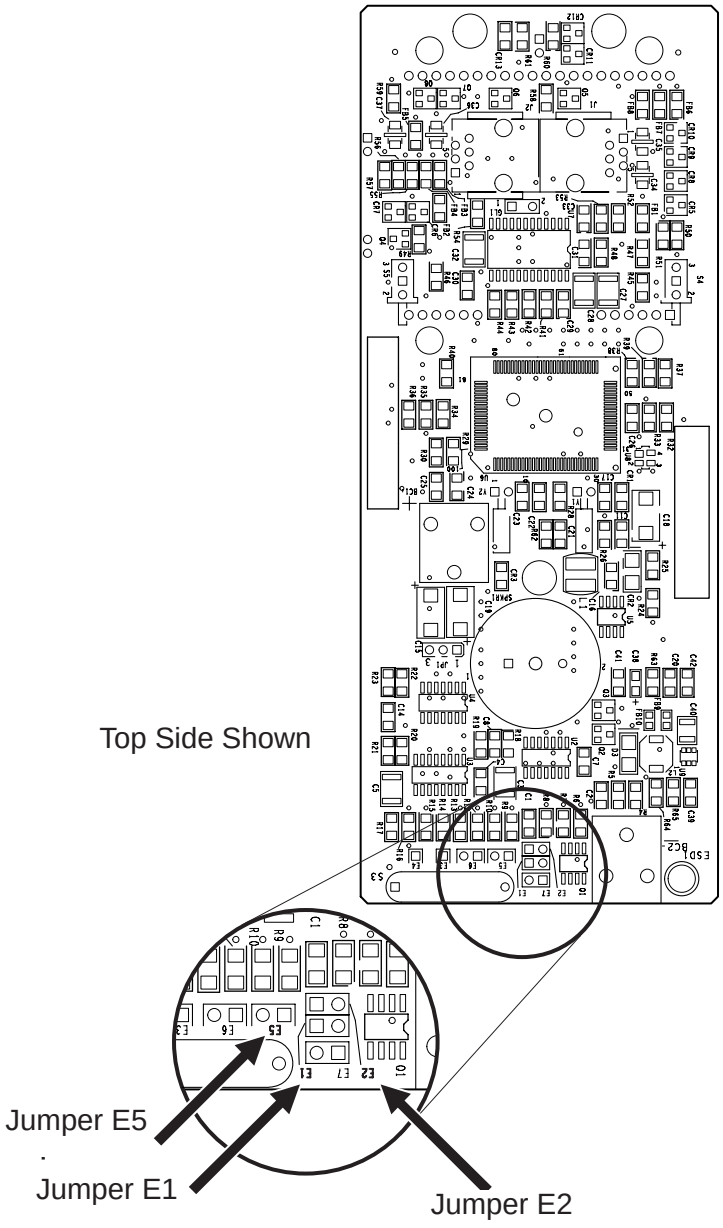


## 5.2 DISASSEMBLY/REASSEMBLY (Continued)

### 5.2.2 Anti-Theft Timer Configuration

With the case open and circuit board accessible, install jumpers to configure the Anti-Theft Timer (Figure 5-2).

**Figure 5-2. Anti-Theft Jumper Configuration**



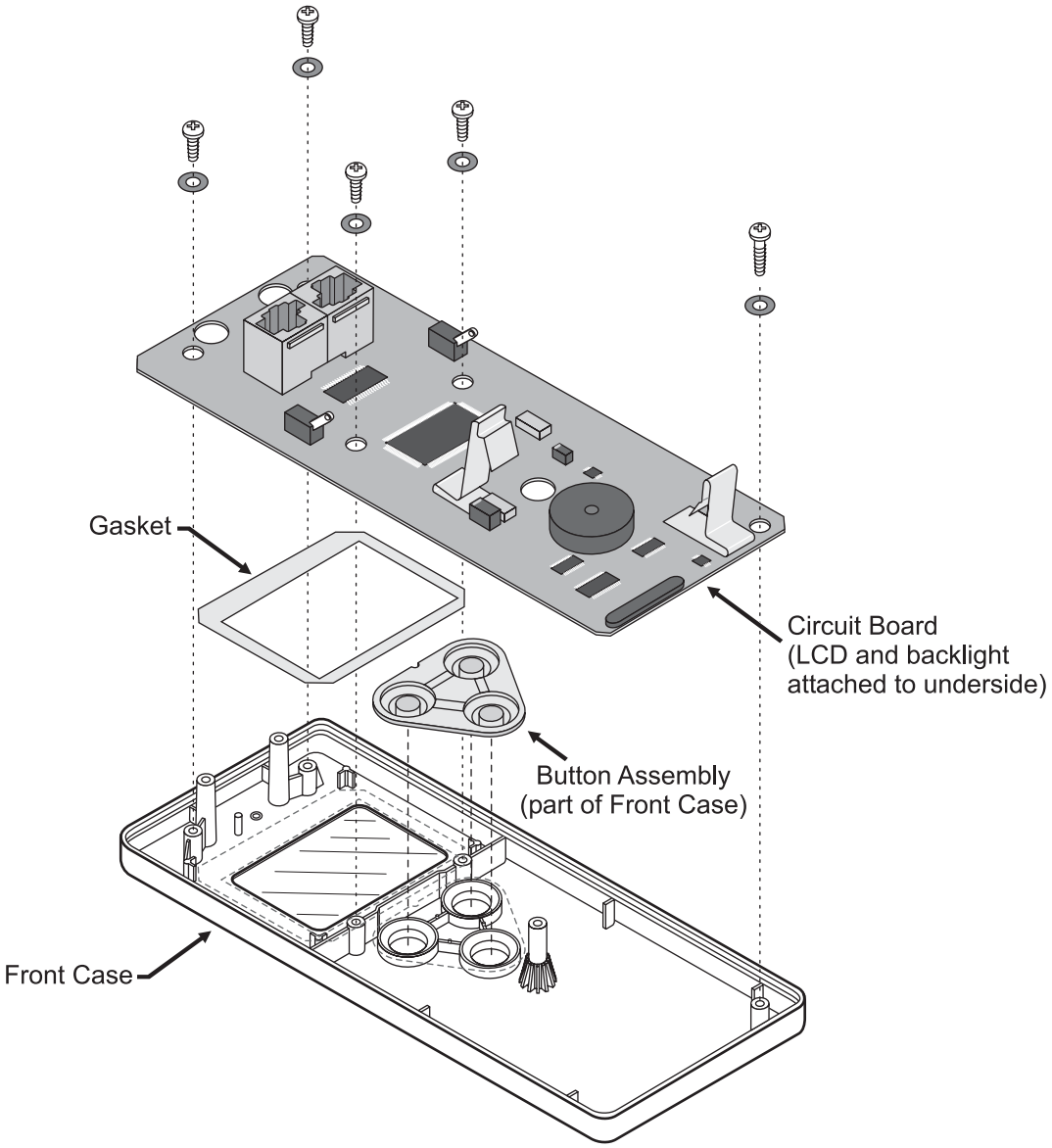

| O = no jumper<br>X = jumper installed | E1 | E2 | E5 |
|---|---|---|---|
| Anti-theft interval: 1 hour | O | X | |
| Anti-theft interval: 8 hours | X | X | |
| Anti-theft alarm disabled | O | O | |
| | X | O | |
| Alarm audio: 3 beeps | | | O |
| Alarm audio: continuous | | | X |

## 5.2 DISASSEMBLY/REASSEMBLY (Continued)

### 5.2.3 Circuit Board

1. Remove 5 screws and washers that hold the circuit board to the front case (Figure 5-3).
2. Gently rock the circuit board loose from the front case.

**Figure 5-3. Circuit Board**

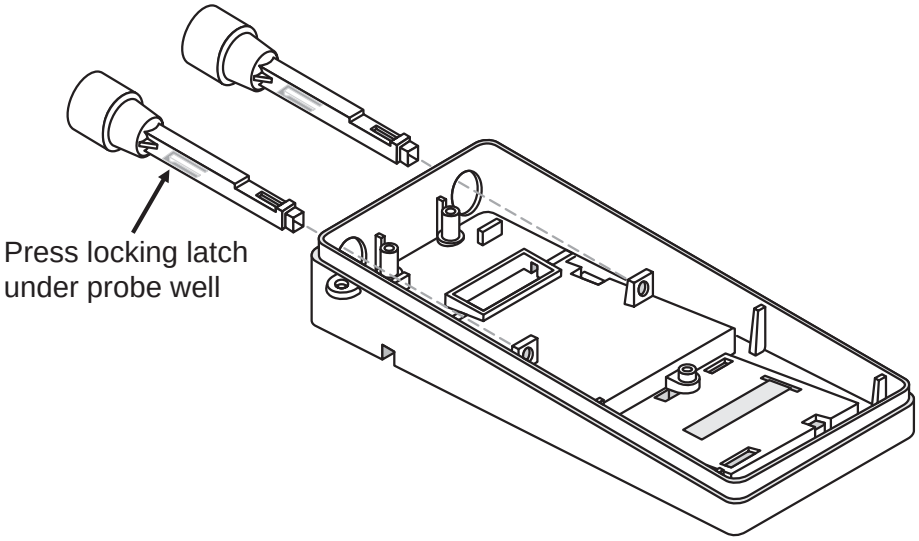


## 5.2 DISASSEMBLY/REASSEMBLY (Continued)

### 5.2.4 Probe Wells

1. Each well has locking latch that holds it in place (Figure 5-4).
2. Use a tool that can reach under each probe well to release locking latch: slide the well from the rear case while pressing the latch.

**Figure 5-4. Probe Wells**



## 5.2 DISASSEMBLY/REASSEMBLY (Continued)

### Table 5-2. Level of Testing Guidelines

| Tests to Perform / Service Procedure | Visual Inspection | Startup Check | Pulse Timer Check | Calibration Check | Cleaning |
|---|---|---|---|---|---|
| Battery Replacement | | X | | | |
| Circuit Board Replacement | | X | X | X | |
| Front/Rear Case Replacement | | X | X | | |
| Probe Replacement | | X | | | |
| Preventive Maintenance | X | X | X | X | X |
| Thermometer Dropped | X | X | X | X | X |

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# 6 TROUBLESHOOTING

# Chapter 6 — TROUBLESHOOTING

⚠ Because circuit board components are not field serviceable, this manual does not include schematics.

## 6.1 INTRODUCTION

This chapter describes possible technical problems and operating errors that may occur while using the Alaris® Tri-Site thermometer. Refer to this chapter before attempting to service the thermometer.

If a problem occurs, first check that:

- The thermometer is being operated correctly (according to the DFU).
- Batteries are installed correctly and do not need to be replaced.
- The anti-theft timer interval has not expired.

## 6.2 SELF-TEST

The thermometer performs self tests every time it is used and whenever the batteries are replaced.

If an error is detected, an error code appears and the thermometer stops working. Tables 6-1 and 6-2 describe how to resolve operating problems and error codes.

## Table 6-1. Technical Troubleshooting Guide

Follow the steps in the order they are listed until the problem/fault is corrected.

| Problem | Possible Cause | Solution |
|---|---|---|
| Thermometer inoperative, no apparent power. | Improperly installed, depleted, or missing batteries. Faulty battery contacts. Short circuit on circuit board. | 1. Check battery orientation.<br>2. Repair or clean battery contacts.<br>3. Replace batteries.<br>4. Replace circuit board. |
| Thermometer inoperative, power present on circuit board. | Improper CPU reset. | 1. Remove and replace batteries.<br>2. Replace circuit board. |
| Thermometer unexpectedly resets. | Intermittent battery contact. | 1. Verify correct battery installation.<br>2. Repair or clean battery contacts. |
| Short battery life. | Excessive backlight usage.<br>Short in battery holder.<br>Thermometer operating during storage. | 1. Verify that thermometer is not stored in an active or alarm state.<br>2. Repair or clean battery contacts.<br>3. Perform Startup Check Backlight Test (see *Preventive Maintenance,* Chapter 3).<br>4. Remove batteries when storing thermometer for extended periods. |
| Error message appears. | Thermometer error detected. | See Table 6-2. |
| Low Battery/Replace Battery symbol/message, but batteries are good. | Faulty reference voltage or CPU. | Replace circuit board. |
| Thermometer does not respond. | Faulty CPU or circuit board connections. | 1. Verify CPU and circuit board connections.<br>2. Replace circuit board. |
| Missing or faint display segments. | Faulty LCD or circuit board connections. | 1. Verify CPU and circuit board connections.<br>2. Replace circuit board. |

**Table 6-1. Technical Troubleshooting Guide** (Continued)

| Problem | Possible Cause | Solution |
|---|---|---|
| Backlight does not function correctly. | Faulty backlight or light sensor. | Replace circuit board. |
| Beeper does not function correctly. | Faulty speaker or speaker drive circuitry. | Replace circuit board. |
| Thermometer enters Continuous/Monitor mode unexpectedly. | Inadequate tissue contact, initial probe temperature too high, defective heater element in probe tip, stuck Mode button. | 1. Allow probe to cool before use.<br>2. Verify that buttons are clean and can move freely.<br>3. Replace probe. |
| Return to Base message or symbol does not reset when thermometer returned to home base. | Defective magnet in home base, incorrect jumper configuration on circuit board, defective circuit board. | 1. Try another home base.<br>2. Check circuit board jumpers E1 and E2.<br>3. Replace circuit board. |
| Broken probe indicator, but probe is good. | Ambient temperature out of specified operating range, defective circuit board. | 1. Verify that ambient temperature is within specified range.<br>2. Replace circuit board. |
| Out of specification readings in Continuos/ Monitor mode using water bath. | Defective probe or circuit board. | 1. Replace probe.<br>2. Perform Calibration Check (see *Preventive Maintenance*, Chapter 3) |
| Pulse Timer does not work or difficult to start. | Anti-theft timer has expired, thermometer in an alarm state, probe not returned to well within 5 minutes of temperature measurement, or defective Pulse Timer button. | 1. Return probe to well.<br>2. Return thermometer to home base.<br>3. Clear any alarms.<br>4. Replace front case assembly.<br>5. Replace circuit board. |

**Table 6-1. Technical Troubleshooting Guide** (Continued)

| Problem | Possible Cause | Solution |
|---|---|---|
| Temperature Recall does not work. | Most recent temperature measurement was not in Fast mode, defective Recall/Scale button. | 1. Verify that most recent temperature measurement was in Fast mode.<br>2. Replace front panel. |
| Removing probe from well does not start thermometer. | Probe not fully inserted into well, thermometer in an alarm state, defective probe, well, or switch. | 1. Verify that probe is fully inserted into well.<br>2. Clear any alarms.<br>3. Replace probe.<br>4. Replace well.<br>5. Replace circuit board. |
| Returning probe to well does not deactivate thermometer. | Probe not fully inserted into well, thermometer in an alarm state, anti-theft alarm active, defective probe, well, or switch. | 1. Verify that probe is fully inserted into well.<br>2. Return thermometer to home base.<br>3. Clear any alarms.<br>4. Replace probe.<br>5. Replace well.<br>6. Replace circuit board. |
| Calibration check failure. | Defective probe simulator or thermometer. | 1. Verify that probe connection and jack are clean.<br>2. Replace probe.<br>3. Replace probe simulator, if used.<br>4. Replace circuit board. |

## Table 6-2. Error Messages

| Error Message | Possible Cause | Solution |
|---|---|---|
| 1 | Both probes removed from storage wells: the thermometer does not operate with both probes removed. | Replace at least one probe to storage well or disconnect probe from back of thermometer. |
| 2 | Incorrect probe inserted into well (blue probe in red well or red probe in blue well)<br>Broken or disconnected probe inserted into one well while the other probe is connected but not in its well. | Check that probes are inserted into correct wells and that probes are securely connected to jacks. |
| 3 | Probe connected to incorrect jack. | Check that oral (blue) probe is connected to jack #2 and that rectal (red) probe is connected to jack #1. |
| 4 | One or both probes are inserted in wells but connectors are not connected to jacks, or broken probe(s). | Check that probes are connected to correct jacks. If problem persists, try replacing probe(s). |
| 67 | Broken oral (blue) probe detected. | Replace oral probe. |
| 68 | Broken rectal (red) probe detected. | Replace rectal probe |
| 69 | Reference voltages from analog to digital converter (ADD) out of tolerance. | Replace circuit board. |
| 70 | ADD calibration phase timeout. | Replace circuit board. |
| 72 | RAM test failure. | Replace circuit board. |
| 73 | ROM CRC failure. | Replace circuit board. |
| 74 | Heater interlock fault or defective probe. | Replace probe. If problem persists, replace circuit board. |
| 75 | Internal fault. | Replace circuit board. |

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# 7 ILLUSTRATED PARTS BREAKDOWN

# Chapter 7 — ILLUSTRATED PARTS BREAKDOWN

## 7.1 INTRODUCTION

The illustrated parts breakdown for the Alaris® Tri-Site thermometer shows its major assemblies.

## 7.2 ILLUSTRATIONS

Use the exploded views to identify the parts of each assembly. Item numbers (the numbers in bubbles) in the illustration correspond to the item number in the parts list. A part that does not have an item number is part of a higher assembly.

**NOTE:** Due to product changes over time, illustrations in this chapter can differ from the instrument under service. See applicable Service Bulletins or contact Cardinal Health Technical Support for more information.

## 7.3 PARTS LIST

The parts lists include the following information for replaceable parts :

- Item: This number corresponds to the item number in the illustration.
- Description: Description of the part.
- QTY: Total number of each item used.

## 7.4 ORDERING PARTS

Parts can be ordered by writing or calling Cardinal Health Customer Service (refer to "General Contract Information" page at beginning of this manual). When requesting a part, provide the following information:

- Instrument name and model number; for example, “Tri-Site 2280OR.”
- Part description, as provided in parts list.

## Table 7-1. Parts List

| Item | Description | QTY |
|---|---|---|
| 2 | Case Assembly, Front/Label, Tri-Site<br>North America<br>International | 1 |
| 17 | Screw, TPG, #4-20 x 1.23 PNH PHL | 2 |
| 18 | Screw, TPG, #4-20, 0.625 PNH PHH | 1 |
| 33 | Gasket, Tri-Site | 1 |
| 34 | Circuit Board Assembly<br>North America<br>International | 1 |
| 36 | Wrench, Hex, 5/64 ACR FL (P/N 301485) | 1 |
| 37 | Washer, Flat, 0.146 x 0.270 x 0.032 Fiber | 5 |
| 38 | Screw, TPG, #4-20 x 0.25, PNH PHH | 4 |
| 39 | Screw, Trilob, #4-20 x 5/16 PHL PNH ZPL | 1 |
| 44 | Case Assembly, Rear, Tri-Site | 1 |
| 45 | Well, Probe, Oral | 1 |
| 52 | Jumper, Battery 228X | 2 |
| 61 | Strap, Carrying, 2X8X (P/N 122854) | 1 |
| 63 | Well, Probe, Rectal | 1 |
| 65 | Pad, Mounting, Foam/Dbl Adh (P/N 127842) | 1 |
| 66 | Cover, Battery, 2X8X | 1 |
| 67 | Screw, TPB, 8 x 3/4 PNH PHH | 4 |
| 68 | Screw, Anchor, 8-10 x 7/8 | 4 |
| 69 | Battery, Alkaline, Size AA (P/N 303590) | 3 |
| 96 | Label<br>Sublingual Pocket, Model 2117/2118<br>Oral Probe Placement International | 1 |

**Table 7-1. Parts List** (Continued)

| Item | Description | QTY |
|---|---|---|
| 97 | Label, Home Base<br>Portable Tri-Site<br>Alaris Tri-Site | 1 |
| 98 | Home Base<br>(P/N 2117)<br>(P/N 2118) | 1 |
| 100 | Holder, Probe Cover Box, 2X85 (P/N 134994) | 1 |
| 101 | Washer, 2X85 (part of Item 100) | 1 |
| 102 | Pad, Foam, 2X85 (part of Item 100) | 1 |
| 607 | Directions for Use (DFU), Tri-Site (included in Service Manual Assembly) | 1 |
| 608 | Label, Operating Instructions, Tri-Site<br>Portable, English<br>Portable, International<br>Wall Mount, English | 1 |
| 635 | Label, Name Rating, Tri-Site<br>English<br>International | 1 |
| 636 | Label, Battery Replacement, Tri-Site, International | 1 |
| 642 | Label, Anti-Theft, English (North America only) | 1 |
| 650 | Label, Serial Number | 1 |
| 712 | Probe, Tri-Site, Oral, Long (Model 3887) | 1 |
| 713 | Probe, Tri-Site, Rectal, Long (Model 4888) | 1 |
| 714 | Bracket, Probe Cover Dispenser (P/N 896) | 1 |
| | Probe Simulator (P/N TE 1811) | 1 |

**Figure 7-1. Label Placement**

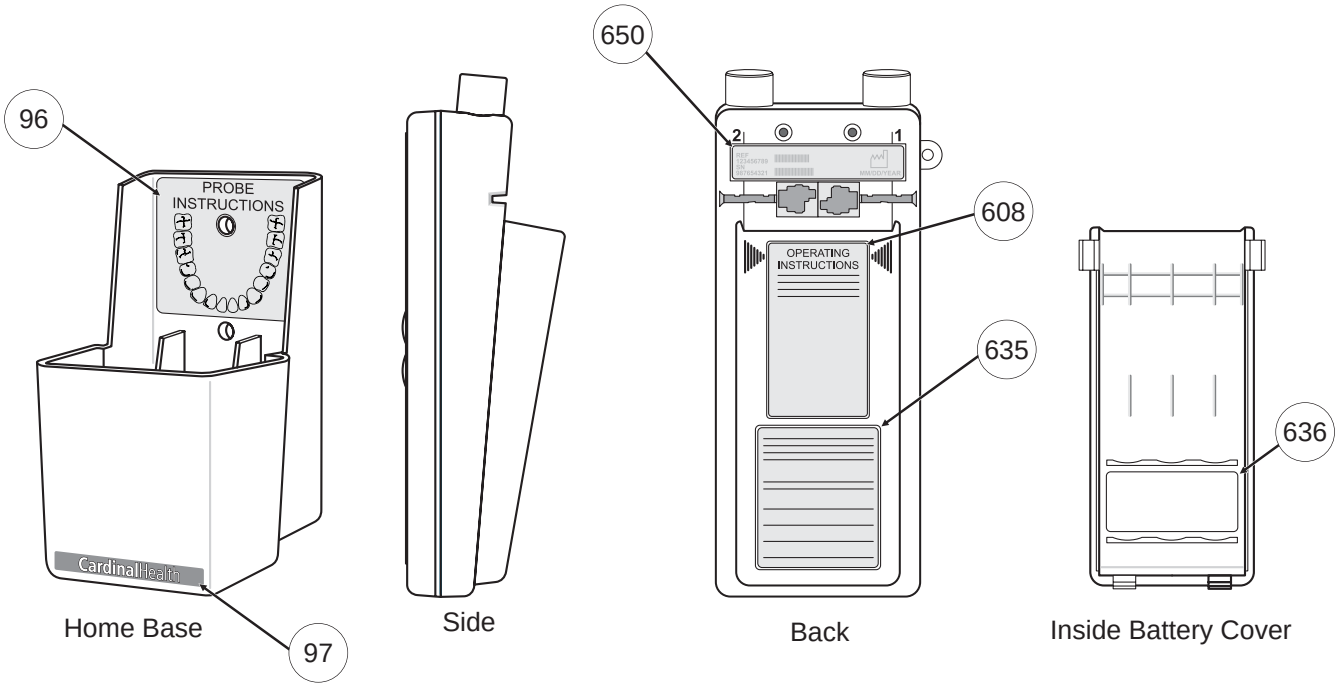


**Figure 7-2. Front/Rear Case, Battery Compartment**

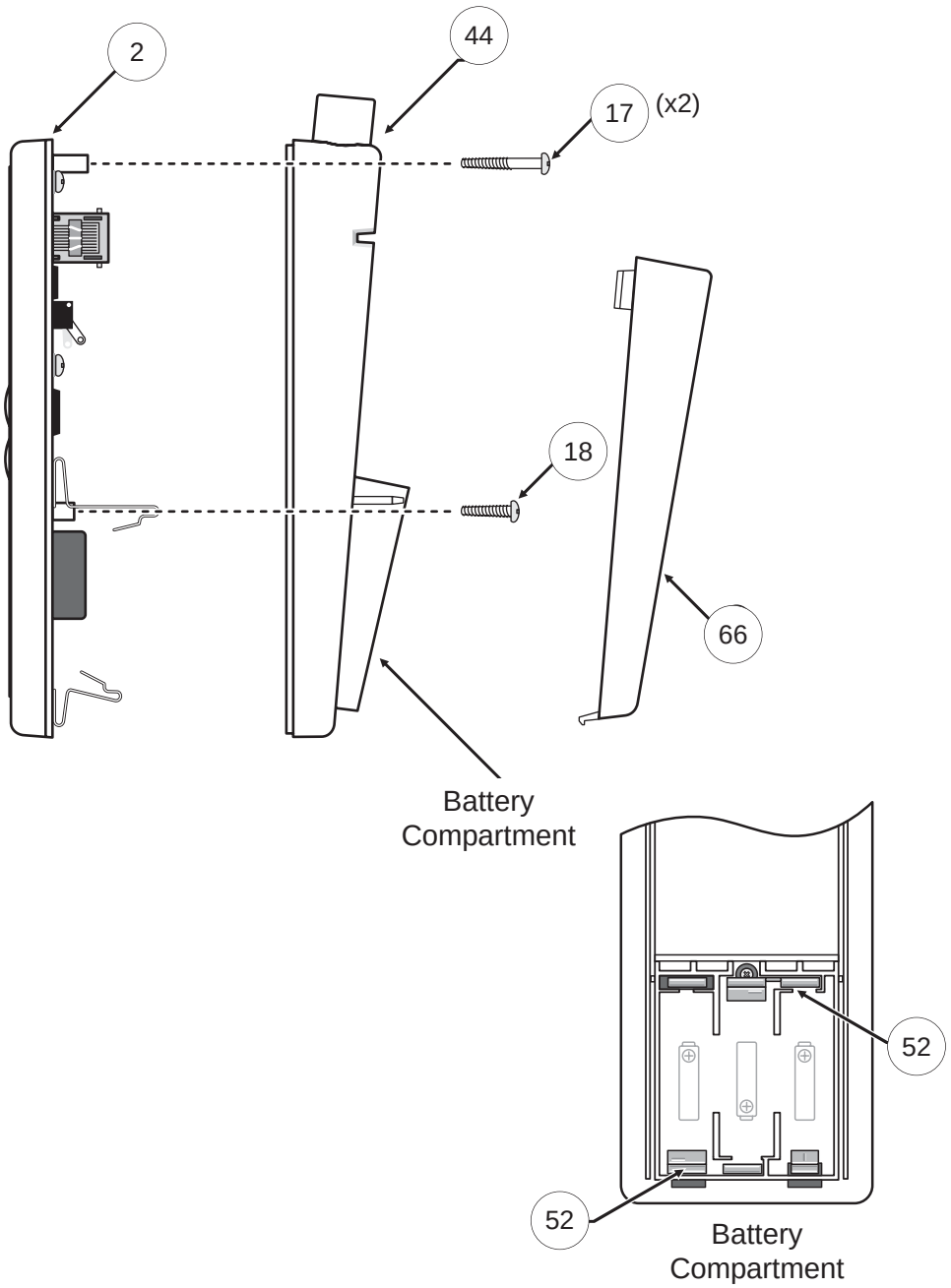


**Figure 7-3. Circuit Board Assembly**

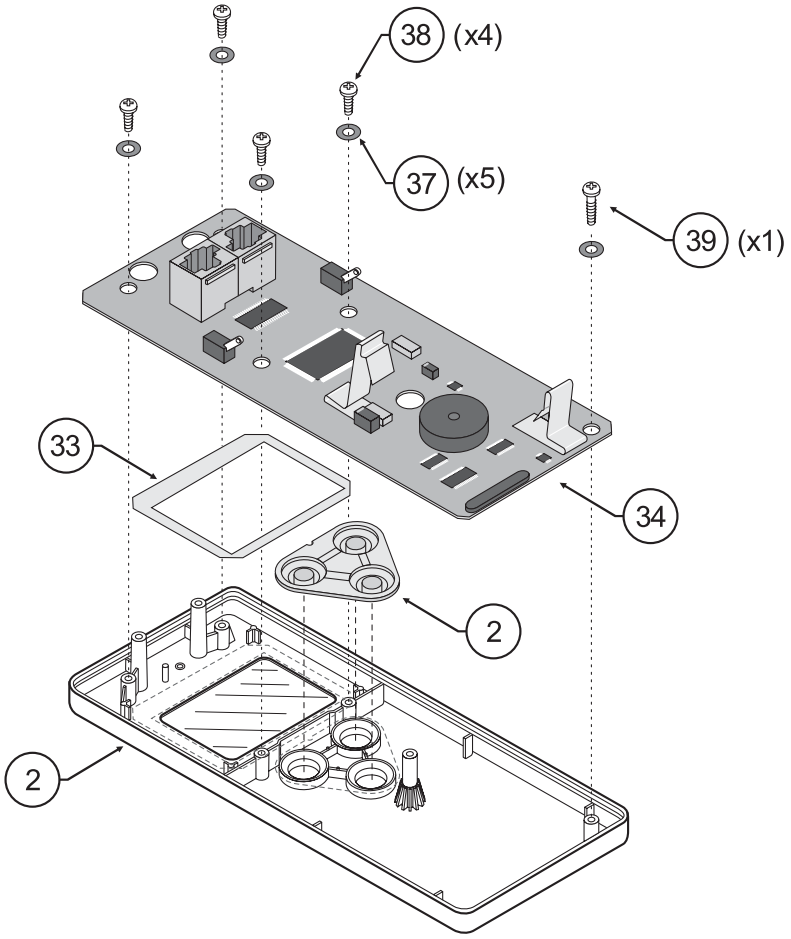
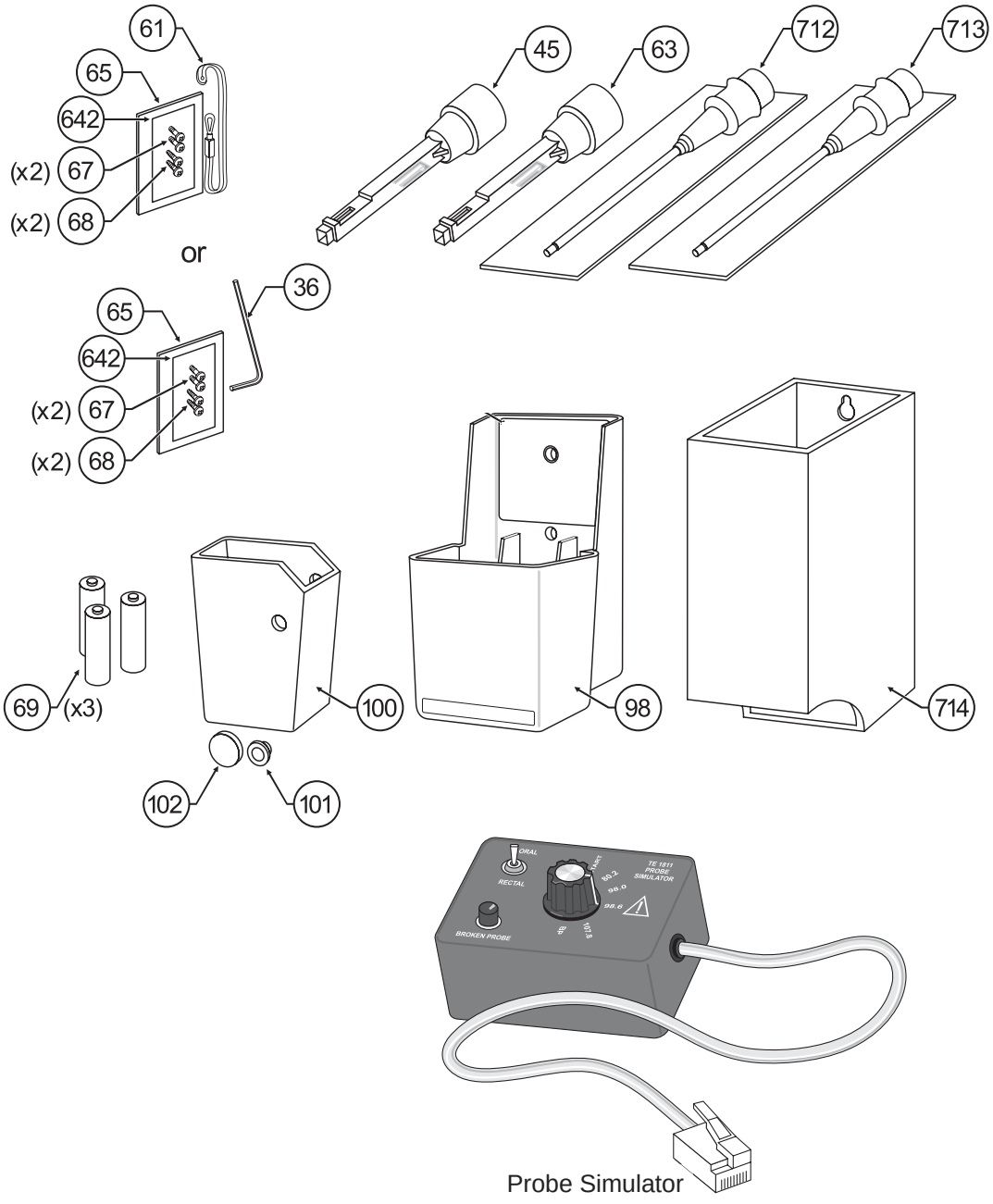


**Figure 7-4. Accessories**



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